California Department of Fish and Game Climate Change Research Considerations



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Climate Change Research: A Collaborative Approach

The California Department of Fish and Game (DFG) is aggressively implementing a strategy to manage the impacts of climate change on wildlife and habitat. In keeping with its mission, DFG is committed to reducing the impacts of climate on the state's natural resources and helping all species to adapt to these changes to the greatest extent possible.

DFG has taken a leadership role among the state fish and wildlife agencies to begin to address the uncertainty associated with our changing climate through landscape-scale efforts that support managing robust populations and healthy habitats – the best way to ensure success in the face of an uncertain future. Our staff represents wildlife interests on the climate action-working group of the Western Governor's Association, the climate change committees for the Association of Fish and Wildlife Agencies and the Western Association of Fish and Wildlife Agencies, and the steering committees for the CA LCC and the National Fish, Wildlife, and Plants Climate Adaptation Strategy. The DFG also works with partners like the CEC-PIER program and is part of the CAT research subgroup to actively support climate change research priorities. These collaborative efforts have informed the development of DFG's research goals (see below) that will enable the Department to incorporate climate change into new and on-going activities.

Opportunities to Integrate Climate Change Research into Department Activities

The DFG is committed to building on existing tools and expertise and to initiating and collaborating on new research as resources become available. Because there will always be some uncertainty about future climate change impacts and the effectiveness of proposed management strategies, new research and careful monitoring coupled with management approaches that accommodate uncertainty will be required. One area of particular interest to the DFG is the need for climate change vulnerability analyses that can produce spatially-explicit assessments of the impacts of climate change on fish, wildlife, and plants. This is a large and complex task given the size and diversity of the state and the DFG is working with partners on a variety of climate change vulnerability assessments. In addition, the revision of the California Wildlife Action Plan (Action Plan) provides an opportunity for including climate change planning and research into DFG priority programs and projects. The Action Plan identifies climate change as one of four primary stressors affecting wildlife (along with growth and development, water management conflicts, and invasive species) and makes recommendations to incorporate climate change science in restoration work. An upcoming revision of the Action Plan offers an opportunity to more fully integrate climate change throughout the document and many of the DFG's on-going or pending research is intended to support the revision.

The Action Plan is scheduled to be revised by 2015. Primary objectives of the revision are to incorporate new information developed through updates to Species of Special Concern documents for birds, mammals, reptiles, amphibians, and fish; update the stressors and actions affecting fish and wildlife on an ecoregional scale; expand the analysis of threats posed by climate change and down-scale the States Adaptation Strategy to on-the-ground, implemental actions that will build resiliency for species adaptation. Teams have been formed to guide the development of the two phase update.

The first phase will focus on a statewide vulnerability assessment that brings together varied taxon-specific analyses into one assessment that can be used to inform the Action Plan's lists of Species of Greatest Conservation Need (SGCN). The first phase will also include public scoping and coordination with stakeholders, agencies, and tribes with the goal of making the Action Plan more relevant to all levels of natural resource managers in California. The second phase will involve a chapter-by-chapter review of the first Action Plan, incorporating new science on climate change, species status and distribution, and emerging threats and innovations. The update will draw from new tools such as the **Areas of Conservation Emphasis (ACE)** mapping model, and the **California Essential Habitat Connectivity project** both recently completed by the DFG. Long-term monitoring and resource assessment will be key components of Action Plan implementation and will rely on measures and metrics that can be linked to climate change analysis.

Guiding Principles

As scenarios, models, and projections of climate change on the ground are developed, refined, and ultimately supported by data, the Department will factor these variables into our conservation strategies, planning, and land acquisition and land management priorities. The intent of this effort is to emphasize solutions for long-term conservation needs. To the greatest extent possible the DFG will synthesize, interpret and distribute scientific information about known and potential impacts of climate change on the biodiversity of the state to key decision makers so that it can be widely incorporated into land and water management policy and practices. The DFG can play a key role in the oversight of such efforts and the application of their results.

Staff are continually working to identify research needs that will help the DFG and our partners develop science-based adaptation strategies for managing and protecting species and habitats threatened by climate change impacts, Specifically, the DFG is taking into consideration efforts that:

- *Maintain healthy, connected, genetically diverse populations.*
 - Small isolated populations are more prone to local extirpations than larger, more widespread populations. Although managers already encourage healthy populations, climate change increases the importance of this goal and will likely require adjustments in population targets and in the design of habitat corridors including their restoration and maintenance under changing climate conditions.
- Reduce non-climate stressors on ecosystems.
 - Reducing other human-induced stressors such as invasive species, toxic pollution and habitat loss will minimize negative synergistic impacts associated with climate change and increase the resiliency of habitats and species to the effects of climate change and variability.
- Prevent and control invasive species.
 - Rapidly changing climates and habitats may increase opportunities for invasive species to spread. Extensive monitoring and control will be necessary to limit the negative impacts of invasive species along with an assessment of the likelihood of non-native species invasions.

• *Reduce the risk of catastrophic fires.*

Climate change could lead to more frequent fires and/or a greater probability of catastrophic fires. Managers can use prescribed fires and other techniques to reduce fuel load and reduce the potential for catastrophic fires.

• Protect coastal wetlands and accommodate and plan for sea level rise, ocean acidification and impacts to marine resources.

Managers can defend against the negative impacts associated with sea level rise through conservation easements and the acquisition of inland buffer zones to provide an opportunity for fish, wildlife, and plants to move inland if possible. Ocean acidification can be monitored for adverse effects to marine resources and management actions can be taken when appropriate.

• Adjust yield and harvest models.

As fish and wildlife populations respond both directly and indirectly to climate through changes in habitats, their productivity and sustainability may increase or decrease. Managers may need to adapt yield and harvest regulations both in anticipation and response to these changes.

- Consider climate change models as well as historical data when making projections. Managers must be aware that historical climate, habitat and wildlife conditions are not indicative of future conditions. Projections and planning should take into account expected changes in climate.
- Employ monitoring and adaptive management.

Due to uncertainty concerning climate change, wildlife managers must anticipate the impacts to wildlife and use monitoring data to quickly adjust management techniques and strategies if needed. Traditional, long-practiced methods and strategies may not be as effective as conditions change.

• Identify new opportunities.

Managers must be ready to anticipate and take advantage of new opportunities. For example, if climatic conditions leave existing agricultural areas unusable for agriculture, they could become important wildlife conservation areas with the appropriate agency and landowner collaboration.

Appendix I: Current and Ongoing DFG Climate Change Related Research 2011

Below is a sampling of current climate change related research efforts that the DFG is either leading or collaborating with partners to produce. This is by no means an exhaustive list but provides an overview of some of the efforts in which the DFG is engaged. For more information on any of these projects please contact climatechange@dfg.ca.gov

Integrating Climate Vulnerability into the California Bird Species of Special Concern List

Completed: In collaboration with PRBO Conservation Science, the DFG has updated the <u>California Bird Species of Special Concern report</u> and conducted a climate change vulnerability assessment. Information on vulnerability criteria and the results of the vulnerability assessment ranking can now be viewed online. This report was completed in 2011 and will be available to inform the revision of the CA Wildlife Action Plan.

Implementing Recommendations from Bird Species of Special Concern including climate change

Pending: This information will be available to inform the revision of the CA Wildlife Action Plan.

Climate Change Vulnerability Assessment for Rare Plants

On-going: In collaboration with the California Landscape Conservation Cooperative, the DFG is conducting a climate change vulnerability assessment for rare plants in California. This study potentially serves as a pilot for further comprehensive assessment of all plant species on the DFG Special Plants List and other key plants which serve as habitat for animals of greatest conservation need. This information will be available to inform the revision of the CA Wildlife Action Plan and should be completed in early 2012.

Update Mammal Species of Special Concern with Climate Change ConsiderationsPending: This information will be available to inform the revision of the CA Wildlife Action Plan.

California Bat Conservation Plan

On-going: The DFG is working with UC Berkeley to develop a state-wide conservation strategy for all bat species in California. This report will result in specific recommendations by species, ecoregion, and conservation issue that could also inform the Wildlife Action Plan update. In addition this report will contain qualitative expert opinion on climate change impacts to CA bat species.

California Reptiles and Amphibians: Effects of Climate Change

Pending: Identify Reptile/Amphibian Species of Future Special Concern. This information will be available to inform the revision of the CA Wildlife Action Plan.

Reptile and Amphibians Species of Special Concern Update

On-going: Non-game fish and game priority research collaboration to update the Amphibian and Reptile Species of Special Concern report. This information will be available to inform the revision of the CA Wildlife Action Plan

Update California Wildlife Action Plan including Climate Change Considerations On-going: Will be completed by 2015

Marine Region's On-going Monitoring

On-going: DFG's Marine Region staff digitize commercial catch and effort information that the fishing industry provides to the DFG as required by law. Some of these data are stored on the Commercial Fisheries Information System (CFIS). Marine Region staff also manage the California Recreational Fishery Survey (CRFS) program with samplers collecting information on recreational catch and effort that is also entered into a digital database. Data from both of these programs are being used by researchers and managers to examine temporal trends in fisheries, for the purpose of evaluating both stock status (pursuant to the Marine Life Management Act) and modifications in stock size related to changes in the oceanographic environment related to climate change.

- California Recreational Fishery Survey
- Marine research website

Ocean Acidification

On-going: DFG is one of eight co-investigators participating on a multi-disciplinary team that is conducting field and laboratory experiments to investigate the extent of ocean acidification at a site in coastal California. The team will also examine the effects of elevated carbon dioxide on calcification rates in red sea urchins, mussels and abalone at different life stages, and use molecular tools to link calcification rates with gene expression and document changes in gene expression at elevated seawater carbon dioxide levels. Project title: Ocean Acidification Exacerbated by Coastal Upwelling: Monitoring of CO2 and O2 on the California Shelf, and Studies of Their Effects on Red Sea Urchins, California Mussels and Abalone.

Effects of Climate Change on Inland Fishes of California

On-going: This project includes an analysis of the status and trends of different inland fishes as they are impacted by climate change. Partners include DFG, California Energy Commission, Trout Unlimited, California Trout, Resource Renewal Institute, and the Center for Watershed Sciences (UCD). This information will be available to inform the revision of the CA Wildlife Action Plan.

ACE II: Mapping and modeling effort

Completed: Phase II of the DFG's <u>Areas of Conservation Emphasis (ACE-II)</u> mapping and modeling effort is intended to help the Department identify areas of highest biological and conservation value. By analyzing statewide information on biological richness, including species diversity, rarity, and sensitive habitats, ACE II can be a platform to aid climate change adaptation planning and can directly support efforts to create a system of sustainable, well connected habitat conservation areas across California as detailed in the California Climate Adaptation Strategy.

Elkhorn Slough National Estuarine Reserve

On going: This DFG ecological reserve plays host to several projects related to climate change that are currently under way. Research projects include investigating salt marsh sustainability in the face of sea level rise, water quality monitoring, breeding bird monitoring, and early detection of invasions by non-native species via regular surveys. This information will inform DFG's efforts to protect marine and coastal resources from the negative effects of climate change.

Appendix II: Key Research Questions/Data Needs

The following research questions and data needs are specific to California's Wildlife Action Plan and were identified during the "Climate Change and California's Wildlife Action Plan Workshop" held in June 2008.

Monitoring

- Establish framework for comprehensive research program combining predictive
 modeling and monitoring of focal species to assess changes in the ecological
 resources and assesses viability.
- Long term monitoring to evaluate changes in focal species
- Develop regional climate change scenarios for California relevant to the resources DFG manages.
 - Include micro-region weather data collection protocols and coordinate with other scientists at regional level to ensure repeatability and data integration.
- Need central data bank that synthesizes data for land managers.
- Could be in the form of 'response plans' for different scenarios.
- Need to easily transform data into regulatory schemes and on the ground management plans.
- Use predictive models to focus on which species are most likely to be at risk (sensitivity, likely habitat shifts, etc)
- Population studies
- Demographic studies
- Species tolerance
- Future conditions
- Identify what we are already doing and how to modify
- Identify data gaps for fish, wildlife, and plants.

Connectivity

- Identify critical connections/corridors taking into account changes due to climate change. Model change in precipitation and temperature.
- Linkages should include heterogeneity (soil, vegetation type, elevation, latitudinal).
- More potential to accommodate changes with more habitat variability. Consideration of multiple types of corridors.
- Identify places for things to move on and around DFG lands what might wind up on Federal land?

Changes to Community Composition

- Can we predict community composition changes?
- Emphasize increasing the heterogeneity around protected areas.

Invasive Species

• Predicted response of invasive species. Need better predictive modeling and integration of climate change scenarios into invasive species management.

Water

- Distribution/longevity of surface water for wildlife
- Can we predict changes in composition and structure from precipitation and flow changes for riparian communities?

Fire

• Need data to predict likelihood of fire and model potential habitat change due to climate change where catastrophic events are possible to convert one habitat type to another.

Appendix III: Unfunded DFG Climate Change Research Proposals

For more information please contact climatechange@dfg.ca.gov

- 1. Fisheries and Aquatic Biodiversity Management Planning
- 2. Coordinating Climate Change Activities for Fish and Wildlife Habitat Planning Across the Western Pacific
- 3. Developing Assessments of Climate Change Effects on Western Habitats and Associated Sensitive Species Across Elevational Gradients: A Pilot Project
- 4. Effects of Climate Change on Sensitive Avifauna of the Southwestern United States
- 5. Effects of Early Emergence from Dens by Black Bears at the Urban-Wildland Interface
- 6. Fine Scale Climate Response Modeling of Joshua tree (*Yucca brevifolia*), Incorporating Monitoring and Management Alternatives for Land Management Units
- 7. Habitat-based Species Viability Analysis: Integrating Habitat and Demography to Assess Greater Sage-grouse Viability
- 8. Interstate Migratory Deer Response to Global Climate Change
- 9. Island Populations of Desert Bighorn Sheep: Setting Up a Long-term Framework for Monitoring Metapopulation Status in Relation to Global Climate Changes
- 10. Mitigation by Aeration of Hypoxic Fish Kills in Harbor, Marinas, and Lakes
- 11. Review and Identify Potential Appropriate Metrics, Develop Conceptual and Quantitative Models to Assess Climate Change in State Wide Salmonid Monitoring, Restoration, and Management Plans
- 12. Understanding Impacts of Climate Change on Ecology and Habitats of Waterfowl, Shorebirds, and Other Migratory Birds: Guidance for the Central Valley Joint Venture, Intermountain West Joint Venture, and Other Habitat Conservation Programs in the Pacific Flyway